ENGINEERING X

Pushing engineering science to the Xtreme

Lawrence Livermore National Laboratory
University of California

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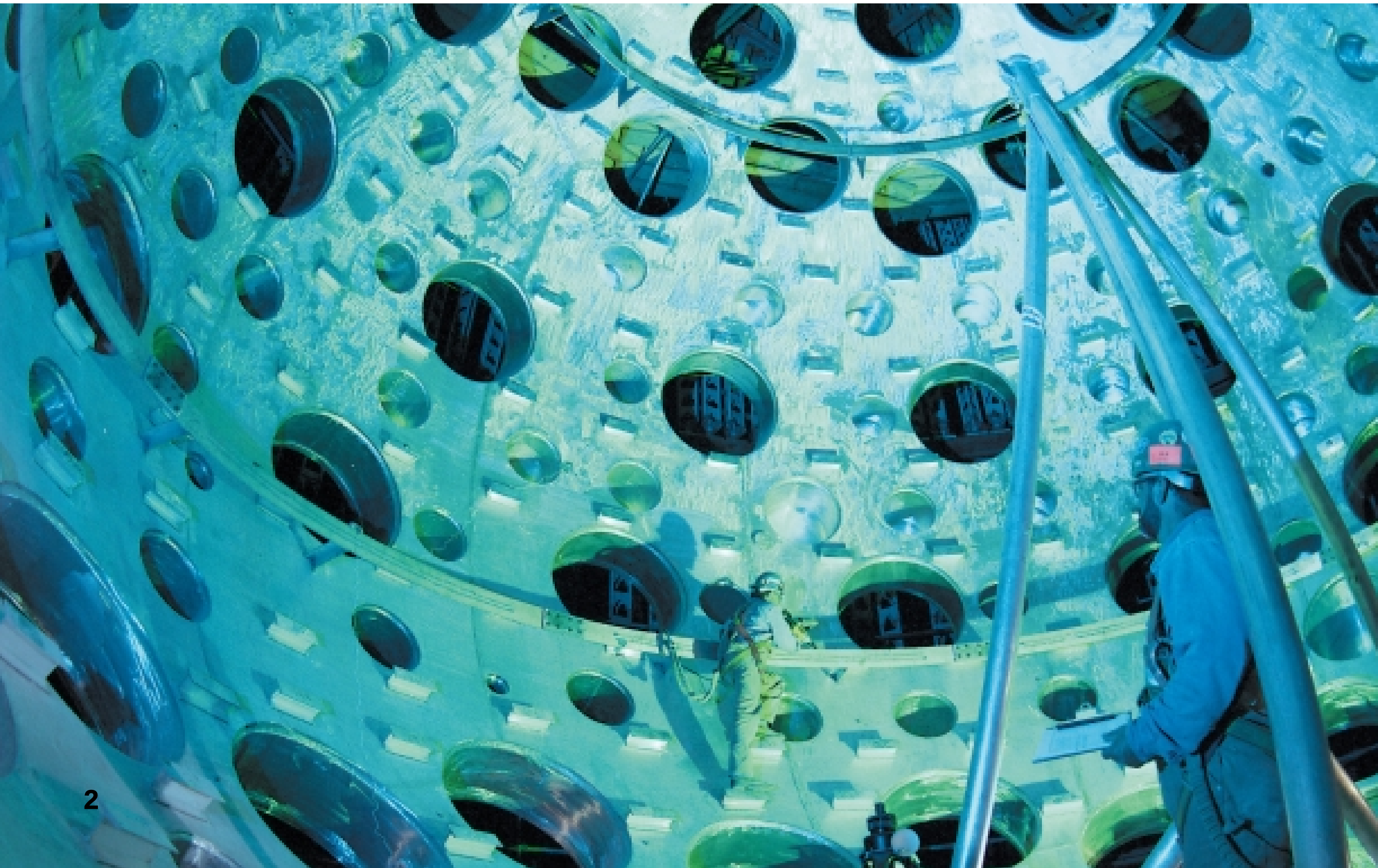
Construction of the target chamber for the National Ignition Facility continues. When completed, the National Ignition Facility will house the world's most powerful laser. In this chamber, 192 laser beams will converge to ignite a spherical BB-size capsule containing fusion fuel.



LAWRENCE LIVERMORE NATIONAL LABORATORY: ENSURING NATIONAL SECURITY

Managed by the University of California for the Department of Energy, Lawrence Livermore National Laboratory employs almost 8,000 people featuring a diverse set of technical skills. With a capital plant value of $4 billion and annual operating and capital funds of approximately $1.3 billion per year, the Laboratory propels its mission—ensure national security and apply science and technology to solve the important technical problems of our time:

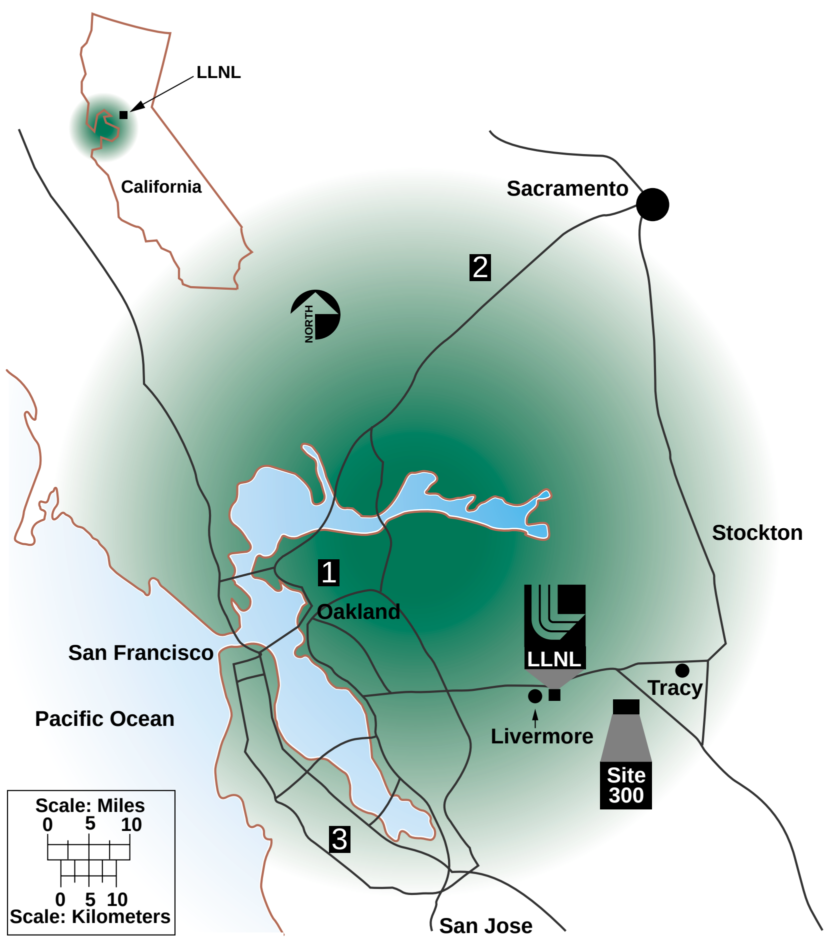
- Provide stewardship of the U.S. nuclear weapons stockpile—by maintaining the weapon safety, security, and reliability while developing new capabilities (if needed).

- Counter emerging security threats—by preventing and defending against the proliferation and use of weapons of mass destruction and other high-tech threats, such as chemical and biological agents.

- Safeguard the nation's future—by developing advanced technologies to address sources of international insecurity and international risk, such as energy, environment, and human health concerns.

Since its founding in 1952, the Laboratory has pioneered science and engineering research in the world. The Laboratory's multi-program, multi-disciplinary approach enables it to meet evolving national needs, whatever they may be. Our technical staff, with its high percentage of Ph.D.s, has been called the "best minds in the business."

Daily operation of the Laboratory is managed by the Director's Office with support from nine associate directorates representing programs and disciplines: Defense and Nuclear Technologies; Nonproliferation, Arms Control, and International Security; the National Ignition Facility Programs; Physics and Advanced Technologies; Energy and Environment; Biology and Biotechnology Research; Computation; Chemistry and Materials Science; and Engineering.



Lawrence Livermore National Laboratory is located in the San Francisco Bay Area, close to many major institutions of higher learning and scenic highlights like Yosemite. The Laboratory also employs a remote test site, "Site 300," located in the nearby Altamont Hills.

1 University of California, Berkeley
2 University of California, Davis
3 Stanford University

ENGINEERING—COMBINING THE BEST MINDS, TECHNOLOGIES, AND FACILITIES

Are you looking for a place where you work on some of the nation's most challenging scientific problems? A place where you can use the most current systems and cutting-edge technologies? Where you will help pioneer "Xtreme Engineering"? If so, consider a career in engineering at Lawrence Livermore National Laboratory.

The Laboratory prides itself on its heritage of technical excellence. This heritage rests first and foremost with its people. From the Lab's very beginnings, engineers have been key in establishing and maintaining the Lab's world-wide reputation for multidisciplinary research and development.

From lasers and electro-optics research to the human genome project, Laboratory engineers make unique contributions to a diverse range of nationally important issues.

In Engineering, our mission is to make the Laboratory's programs succeed and grow. Today Engineering is pioneering "Xtreme Engineering" technologies that extend the range of solutions from microscale to ultrascale, often simultaneously.

As an engineer at the Laboratory, you will have challenging assignments and be involved in projects from inception to completion. You will find opportunities to enhance and build upon your skills, opportunities to advance your career, and access to exceptional facilities and systems. As one engineer put it, "The only limits are the ones you set within yourself."

Engineers work with others at the Laboratory, the Department of Energy, the University of California, and private industry to address national priorities—demanding even smaller parts, faster times, greater power, more complexity, and higher precision. In the last few years, we have developed the world's smallest biomedical instruments, designed the world's fastest aircraft, and are now building the world's largest laser.

Talented people

Creativity and talent are attributes we nurture and recognize. Since 1978, Engineering personnel have won over 38 R&D 100 awards. This international competition judges the most technologically significant new products and processes of the year, or "the Oscars of invention."

"The only limits are the ones you set within yourself."

Cutting-edge technologies

The Engineering organization invests heavily in a portfolio of forward-looking technologies that feature "Xtreme Engineering" advances, pushing the forefront of scientific research and development. As engineers move from program to program and apply these technologies to different problems, the capabilities of these technologies expand, and our engineers build their own incredible toolbox of skills.

State-of-the-art facilities

Engineering furnishes employees with world-class engineering resources, including facilities with unique capabilities. We have over $500 million invested in facilities and equipment that our engineers use to tackle on-the-job challenges. We own and operate about 35 facilities at the main site.

Whether you are a recent college graduate or an experienced engineer, consider joining the Laboratory, where you can enjoy the flexibility of academia and the product-oriented corporate world at the same time. In the following pages, you'll find out more about Engineering and the Laboratory programs. You'll also discover some of the benefits of working at the Lab.

ENGINEERING MAKES LABORATORY PROGRAMS SUCCEED

As the largest technical organization at the Laboratory—approximately 2000 employees combining expertise in mechanical, nuclear, chemical, electrical, electronics, materials, civil, and other types of engineering—we are one of the largest engineering research and development operations in the country.

Nearly 80 percent of our engineers have advanced degrees in a variety of technical areas. Engineers are part of multi-disciplinary research teams that may include physicists, computer scientists, mathematicians, chemists, and geologists. There are also opportunities for independent research.

The "matrix" system allows Engineering personnel to stay in one organization while working on many different projects. You can work directly with other Laboratory programs or other organizations to build a diverse career without ever leaving your home organization.

Engineering conducts innovative research and development in technologies such as:

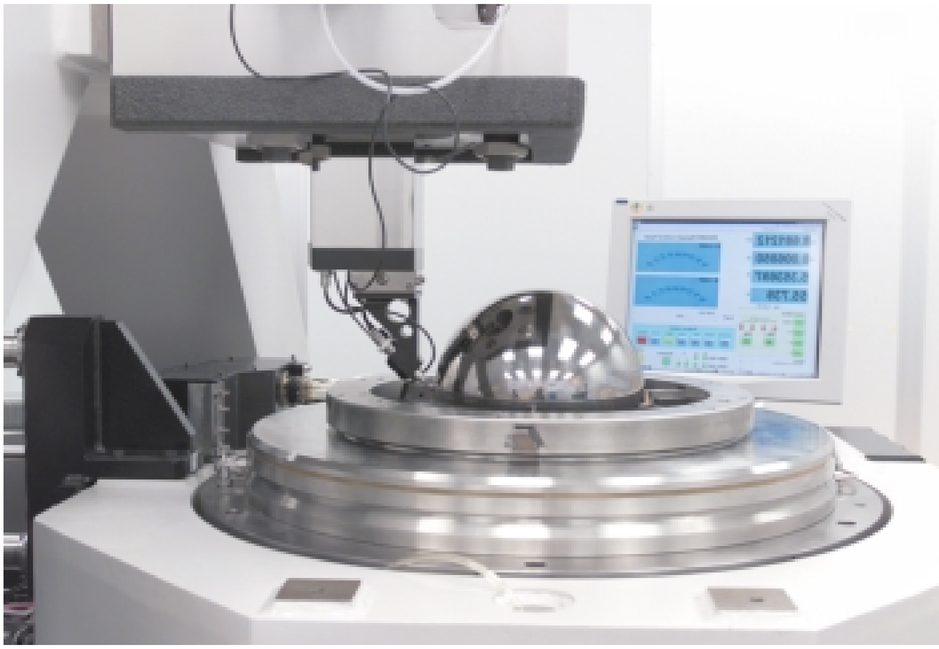
- Electromagnetic and applied mechanics modeling
- Microtechnology
- Laser engineering and electro-optics
- Precision engineering
- Remote sensing and diagnostics
- Image processing and nondestructive evaluation
- Systems assessment, risk, and reliability analysis
- Materials testing and modeling

Our Technology Centers

Established in 1998, Engineering's Centers advance new technologies for the benefit of Engineering and the entire Laboratory.

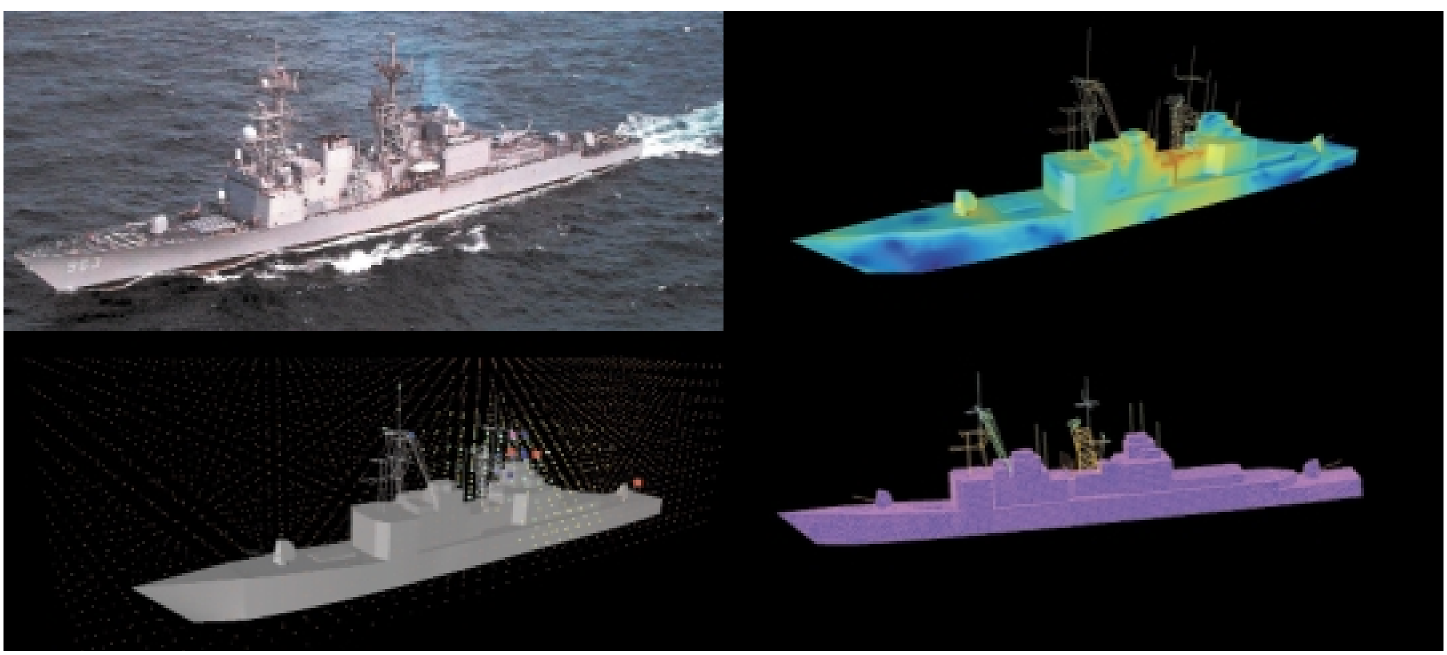
The Center for Computational Engineering develops multi-physics simulation codes emphasizing the use of finite-element technology. The Center combines efforts in solid and fluid mechanics and modeling electromagnetic phenomena from accelerators to electromagnetic propagation.

The Center for Precision Engineering works at the leading edge of processes demanding accuracy on the order of hundreds of atoms, with a strong emphasis on producing parts of high accuracy at reasonable cost. It builds on the principle that "you can't make what you can't measure." Some examples of the Center's work include secondary lenses for the Keck telescope in Hawaii, magneto-resistive read/write heads, and space-based x-ray telescopes.



The precision inspection Shell Measuring Machine measures nonrigid objects for inspecting component parts.

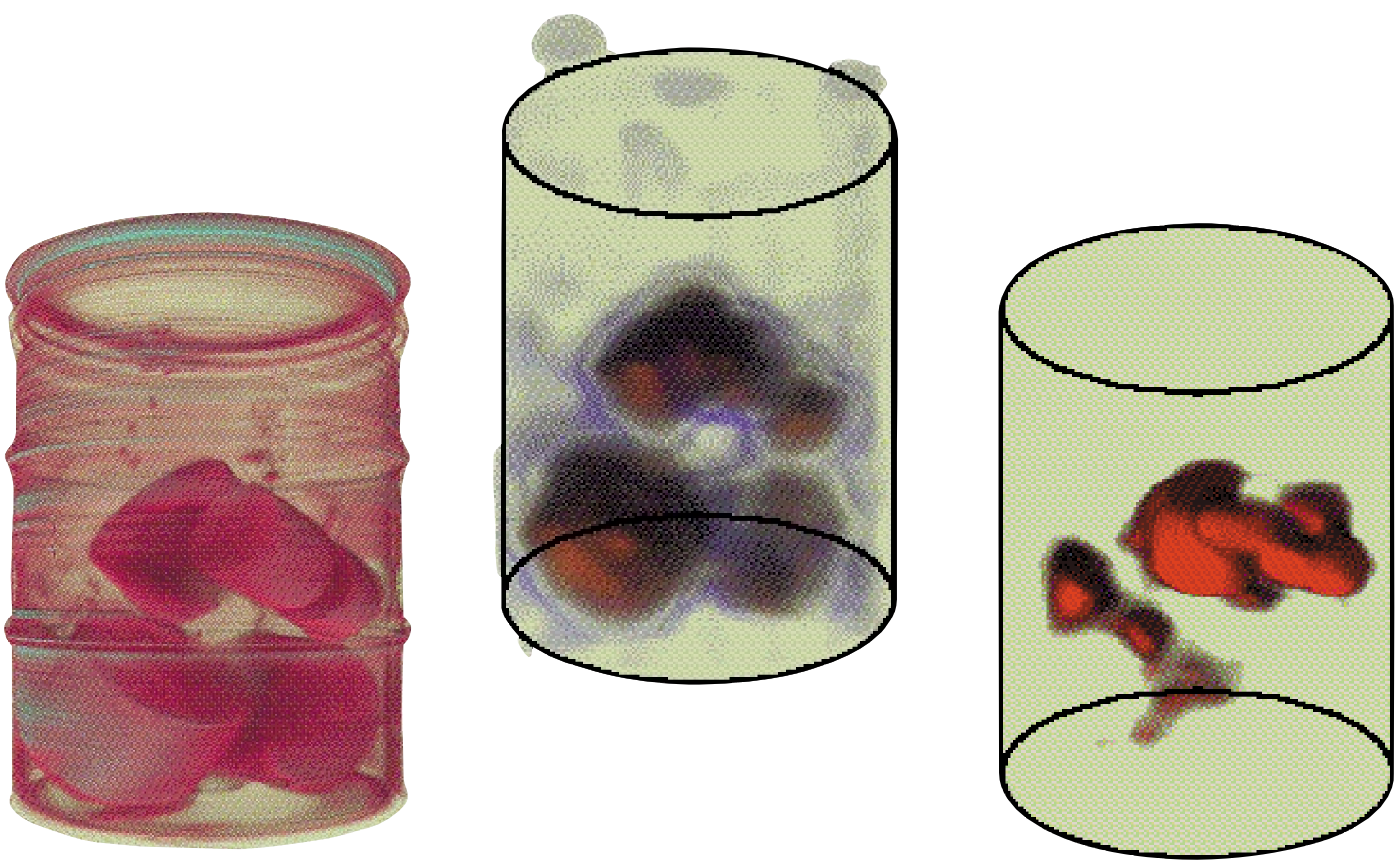
The Electromagnetic Interactions Generalized (EIGER) code helps the Navy design modern ships. This new generation of electromagnetics code can determine where to locate advanced communication systems and how to configure them for optimum performance.



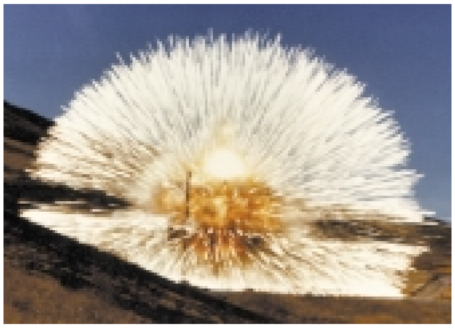
The Center for Microtechnology uses traditional micro-electronic fabrication techniques to design and build micro-electromechanical systems. Some examples of devices fabricated include minimally invasive surgical devices, opto-electronic amplifiers, miniature fuel cells, and biodetection systems based on polymerase sciences.

The Center for Nondestructive Characterization advances technologies similar to Superman's "x-ray vision." The Center uses x-rays, acoustics, and infrared technologies to examine the inside of parts and materials, thus revealing defects or changes in character. The science is similar to conventional medical x-rays and magnetic resonance imaging, but the range of materials that can be examined is much greater.

The Center for Complex Distributed Systems uses measurement and modeling to understand engineering systems with thousands of degrees of freedom. Examples include aerial remote detection, collection, and processing of data from randomly distributed, ground-based sensors; and predicting and measuring the behavior of large suspension bridges to earthquakes.



The R&D 100 award-winning Waste Inspection Tomography for Nondestructive Assay system combines active and passive computed tomography and nuclear spectroscopy (nondestructive characterization techniques) to accurately quantify all detectable gamma rays emitted from the thousands of discarded waste containers across the U.S.



An open-air hydrodynamic test perfeormed at the Flash X-Ray (FXR) facility at Site 300. FXR is a linear induction accelerator used for flash radiography. FXR provides Laboratory scientists with test data for verifying computer-simulated predictions of how imploding objects behave.

Providing Stewardship of the U.S. Nuclear Weapons Stockpile

"Stockpile stewardship and management" refer to our national programs for keeping the country's nuclear weapons safe, secure, and reliable without nuclear testing.

As an engineer supporting the stockpile stewardship and management effort, there are many roles you could take. You could be supporting physics design studies of high-explosive-systems behavior. In this role, you might design, manufacture, assemble, and characterize precision experiments that employ high explosives for instrumented test firings. Or, you could be supporting studies of fundamental laser-material interactions. You might also assist in the precision design, manufacture, and assembly of unique target configurations for high-energy laser experiments.

In stockpile management, you could be involved in the surveillance, refurbishment, and dismantlement of Laboratory stockpile nuclear weapons, along with other related activities. You could be developing structural and thermal computer models to study weapon behavior under transportation, handling, and storage conditions. Or you might be supporting component design, manufacturing, and testing.

Engineers supporting stockpile stewardship and management engage in leading-edge activities such as system performance and phenomenological and environmental testing. They also develop new initiatives that extend state-of-the-art defense technology to related biomedical, industrial, and commercial applications.

Two key elements of the Laboratory's stockpile stewardship effort are the National Ignition Facility (NIF) and the Accelerated Strategic Computing Initiative (ASCI). These two projects represent the world's largest laser and the most powerful computers.

Advanced diagnostics, developed by Engineering, are used to verify performance of reentry vehicles at the Kwajalein Missile range in the Marshall Islands.

National Ignition Facility

As the experimental laboratory facility containing the world's most powerful laser, NIF will focus its 192 laser beams simultaneously onto a tiny target capsule containing fusion fuel. The goal is to create—in the laboratory—the same fusion forces that drive both nuclear weapons and the sun. NIF will provide essential data about weapons safety and reliability. It will also take the country a giant step closer to the goal of power production through fusion energy.

As an engineer supporting NIF, you could be developing software for a state-of-the-art, 35,000-point control system in a distributed, object-oriented environment. Or you might be involved in optics processing, cleaning, and handling in an environment where conditions are extreme and cleanliness is crucial. For NIF, more than 7000 large components must be acquired, inspected, installed, and maintained. Engineers supporting NIF develop and implement diagnostic systems. These systems observe target events on scales of microns and picoseconds in the visible to x-ray spectral region. Engineers also design laser fusion targets—a few millimeters large—containing highly precise details and using unusual materials. Many of these targets must also operate at cryogenic temperatures. You may be developing materials and instruments that can survive a nearby fusion explosion.

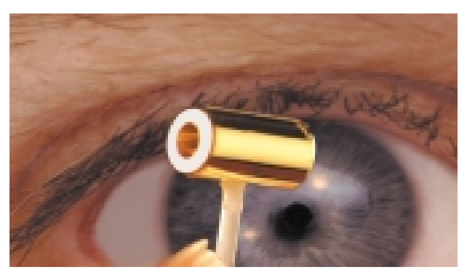
Engineers develop laser diagnostics and targeting equipment of unprecedented precision. They also design equipment that can install several-hundred-pound mechanical packages to a precision of tens of microns in super-clean environments. Finally, there are many operations engineering opportunities in this large, high-tech experimental facility.

The NIF target chamber, where 700 terawatts of laser power will be deposited. This power level equals seven times the output of all U.S. power plants.

Accelerated Strategic Computing Initiative

The ASCI project is developing the world's fastest computers, including the latest machine developed by IBM, ASCI White. This machine uses parallel processing at a speed that has never before been achieved, allowing engineers to model nuclear fusion and fission as an alternative to underground testing. Visualization for ASCI-sized problems necessitates a comprehensive solution based on state-of-the-art visualization hardware, leading-edge visualization research, and a synthesis of commercial tools with in-house software. Tera-scale computing will also provide a commercial platform for medical simulations, global climate modeling, aerospace and automotive design, and other applications having a significant impact on American competitiveness and quality of life.

Mechanical engineers support ASCI by adding advanced physical and numerical models into 3-D Arbitrary Lagrangian/Eulerian hydrodynamics computer codes and by testing codes on weapons engineering problems. Electronics engineers are helping to implement the advanced networking requirements for a tera-scale computing infrastructure.



The NIF indirect-drive (a "hohlraum") target is a hollow metal case the size of a dime surrounding a spherical, BB-size capsule containing fusion fuel. When laser beams enter the open ends and strike the inside wall of the hohlraum, laser energy heats the inside of the hohlraum, creating x-rays that completely surround the target.

Peter Krulevitch

Since joining the Laboratory in 1994, Peter Krulevitch has contributed to cutting-edge research and intellectual property, including nine issued patents. “I wouldn’t have ended up here if it wasn’t for my student internship and post doc position,” said Peter. “I started out as a summer student and had a great experience. When it came time to choose a place to work, I wanted to stay with the team.”

Peter received his Ph.D., M.S., and B.S. in Mechanical Engineering from the University of California at Berkeley. Since then, he has achieved significant technical and programmatic advances.

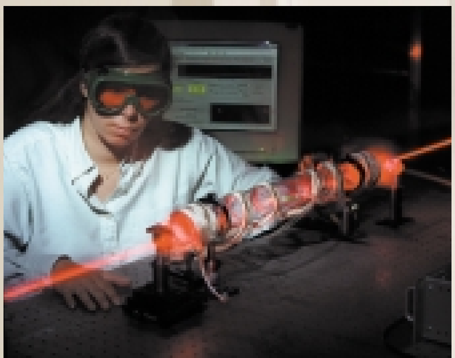
At the start of his career, Peter worked on thin-film-shape memory alloy microactuators, becoming a recognized researcher in the field. He continued his research, teaming with other Laboratory engineers, in a relatively new area for the Lab—biomedical devices. Peter published a frequently referenced paper in the *Journal of Microelectromechanical Systems*, in addition to multiple conference papers and presentations. The team forged new collaborations with industry, universities, and hospitals.

“The Lab is an exciting place to work,” said Peter. “But I still think the people are what make it great. I’ve been able to help recruit outstanding engineers, and together, we’ve built up a tremendous program in biomedical microsystems, a program which continues to grow.”

Today, Peter and his team have helped established the Laboratory as a leader in the detection of chemical and biological warfare agents. Strong collaborations with the University of Texas MD Anderson Cancer Center developing microfabricated systems for separating and identifying cells, along with fabricating therapeutic and surgical microsystems, pave the road for Peter’s future.

“Engineering has been so supportive of me and my career. I’m a researcher, I teach, I mentor students starting out like I did, and my field keeps growing and growing,” said Peter. “What more can you ask for from a career?”

Karla Hagans



When Karla Hagans finished her M.S.E.E. from Georgia Institute of Technology in 1984, she wanted to work with integrated optics, a field still in its infancy. "I discovered that all that cool stuff you learn about in school, all those cutting-edge technologies, aren't really much in evidence in the work world. In '84, not too many places were dealing with integrated optics, but the Lab was."

Karla worked in Lawrence Livermore's underground testing program in the mid-'80s before moving on to the uranium atomic vapor laser isotope separation (U-AVLIS) program in 1990. "One of the fun things about these big projects is that we developed, tested, and deployed the systems we worked on," she said. For the test program, she developed a fiber-optics-based system for diagnosing the physics of nuclear tests. In U-AVLIS, she led a group developing a laser-based diagnostic system. "We developed a simplified version for plant operation, which received a patent," said Karla. Next, she worked on the conceptual design review for the then-proposed National Ignition Facility. After that, she took a one-year assignment in Washington, D.C., as a technical advisor to the Department of Energy's technology transfer program.

Karla returned after her D.C. assignment to head up a group responsible for creating fiber-optics safety systems for nuclear weapons in the stockpile.

"The variety of work here is tremendous," she noted. "The Lab is one of the only places I know where an engineer can work on really big multi-disciplinary projects of national importance. Another thing I like is that, in Engineering, you can move easily from project to project and still have a "home base." I probably wouldn't have had as varied a career if it wasn't for this "matrix" system. The Engineering organization also encourages creativity and an entrepreneurial spirit. Here, you help define the problem, define a solution, and define the path to that solution."

As a new mother of twins, Karla was also pleased with the Lab's benefits program. "I was especially impressed with the support I received from my supervisor," said Karla. "He was delighted I was expecting, and put my health and the health of the babies above any programmatic work concern." Karla was able to return to her job, negotiating a flexible schedule that works for her expanded family.

Countering Significant Emerging Security Threats

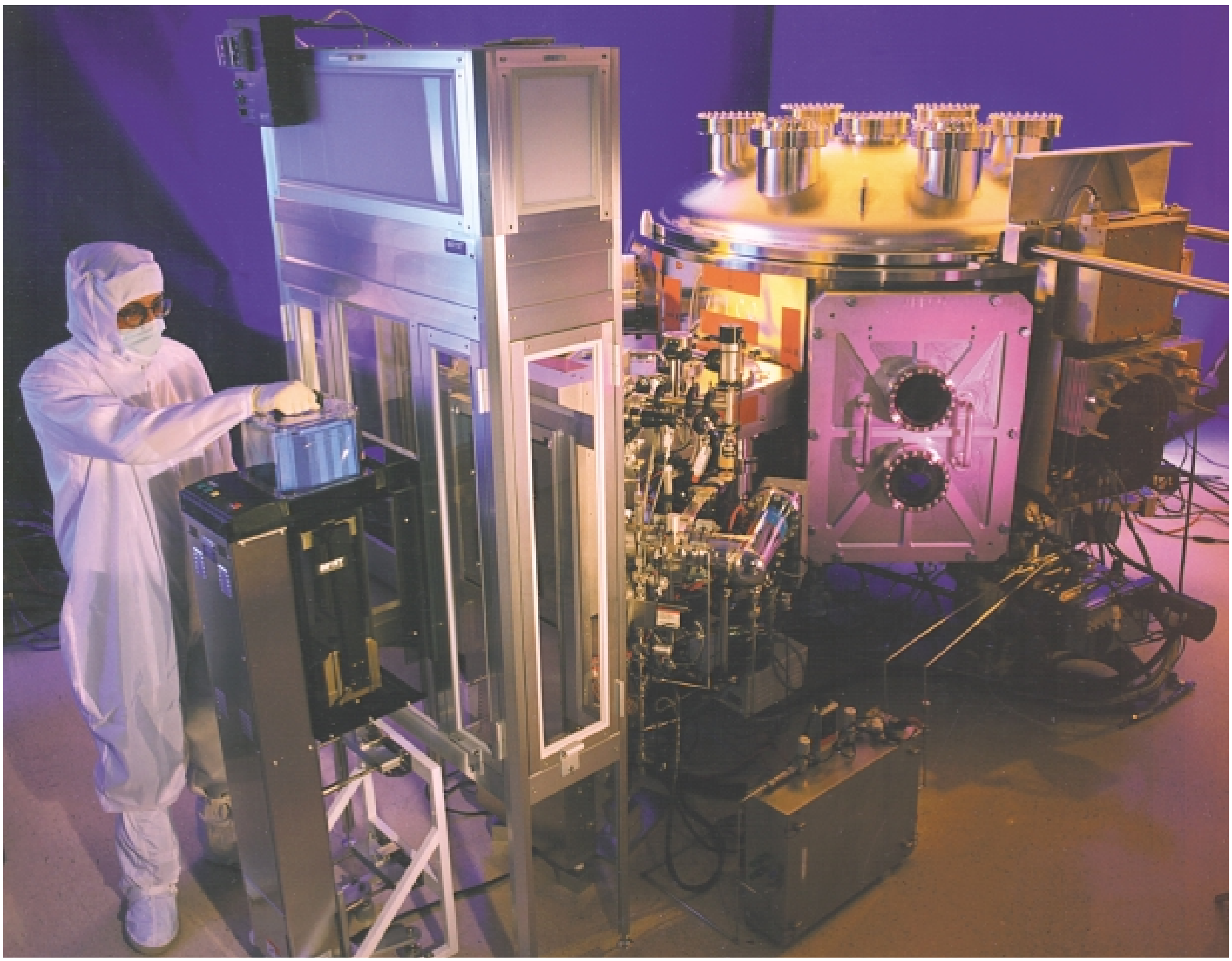
In the nonproliferation and arms control area, Laboratory personnel invent instruments and techniques for monitoring compliance with arms-control agreements. Laboratory staff also provide technical advice to the federal government and to U.S. treaty negotiating teams on what can be detected, measured, and verified.

Engineers play an important part in the Lab's nonproliferation and arms control efforts. They participate in the dialogue with the government and agency representatives. They also provide both leadership and technical staffing for government-funded projects. As an engineer, you would be inventing, modeling, building, and operating the sensors, devices, instruments, and systems needed to achieve project goals. In some cases, engineering inventions lead to new projects.

Remote sensing system deployment

Engineers are developing remote sensing systems capable of being deployed on airborne platforms. These systems are used to detect and analyze very low levels of chemical or biological effluents, aiding in the identification of proliferant nations.

Our research and development program is focused on developing a new generation of sensor systems to



The Extreme Ultraviolet Technology project leads the competition to print the next generation of the world's smallest computer chip.

provide detailed spectroscopic analysis of chemical signatures in waterways, on the ground, and in the air. These technologies include passive infrared imaging and laser-based techniques. The technologies developed under this program may also find use in support of military operations and for monitoring pollution and environment changes impacting regional security issues.

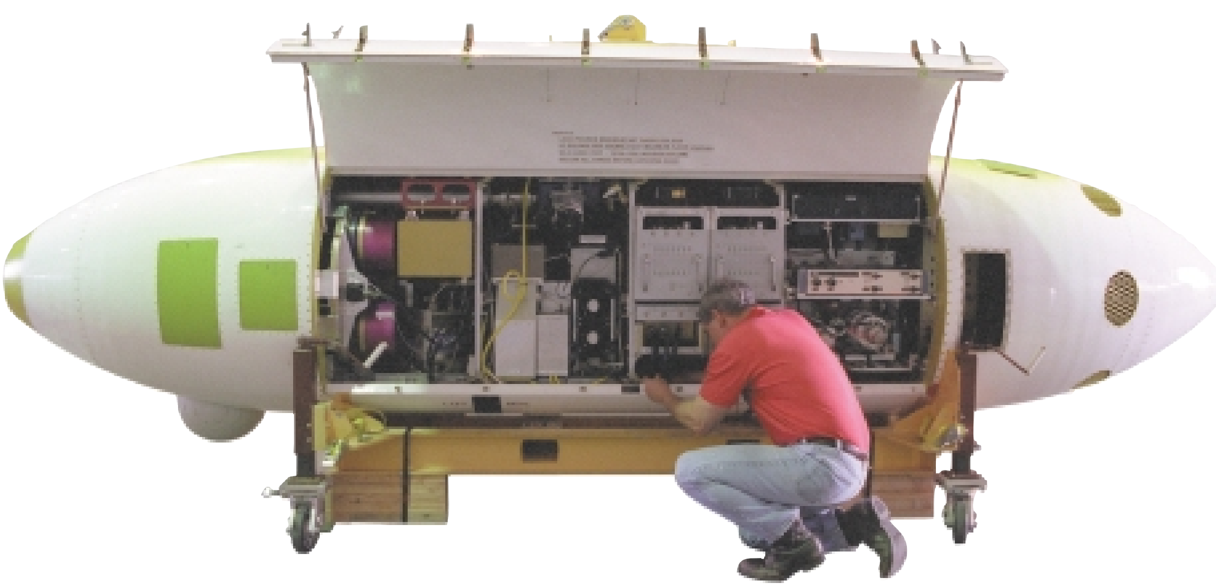
As an electrical engineer on these projects, you could be responsible for developing data acquisition systems to analyze spectroscopic data in near real time or developing advanced laser components and optical measurement techniques. As a mechanical engineer, you could be responsible for developing opto-mechanical systems capable of operating in the challenging airborne mechanical and thermal environments.

Sensor development

To counter the threat of chemical and biological warfare, the Laboratory is developing novel sensor technologies that are compact, easy to use, extremely sensitive, and portable. Lab technologies enable chemical and biological analysis of unidentified constituents to be completed with a hand-held unit, thus replacing time-consuming, complex laboratory chemical and biological analysis. While developed for security applications, these technologies are finding applications in the detection of pollutants and are used to monitor subtle changes in the environment.

The Lab is also developing networked, distributed, point-sensor systems that protect U.S. troops in battlefield scenarios. These systems provide early warning of a battlefield biological or chemical attack. Our research is aimed at networking thousands of individual sensors and pushing the state-of-the-art in networking, radio-frequency communication, and sensor technology. As an electrical engineer on these projects, you might be developing advanced wireless network architectures to monitor and evaluate the responses of thousands of nodes. As a mechanical engineer, you might be involved in the field deployment, demonstration, and evaluation of these systems.

The Handheld Advanced Nucleic Acid Analyzer (HANAA) is a new, portable, polymerase-chain-reaction detector that enables first-responders to detect and identify biological agents in real time at the site of a biomedical incident, such as the deliberate release of anthrax.



Mechanical and electronics engineers created and deployed an effluent species identification sensor system in support of the Laboratory's nonproliferation efforts. The system includes optical remote sensing instruments and atmospheric samplers.

Donn McMahon Profile

Donn McMahon came to the Laboratory in 1995, choosing it over many other options. "The Lab offered the perfect middle ground between the pure research environment of academia and project-oriented industry," Donn said of his decision.

Donn did his undergraduate work at the Massachusetts Institute of Technology and his graduate work at the University of California at Berkeley, earning a Ph.D. in mechanical engineering, with a specialty in control systems, in 1994.

Before joining the National Ignition Facility (NIF) project, Donn worked on engine modeling for hybrid vehicle development and in accelerator technology in support of the Stanford Linear Accelerator Center. These first assignments helped him get oriented and develop breadth, he said, but it's his current work in the Transport & Handling Group of NIF that Donn sees as the best use of his skills in control systems. As part of the group, he designs controls systems for assembly, transport, installation, maintenance, and refurbishing of NIF optics.

Donn's primary roles with NIF are twofold. His first task involves the development of hardware and software control systems for Laboratory-developed optic delivery systems that can be used in an autonomous or semi-autonomous mode. "It's an interesting and challenging job," Donn said, "working with optics weighing as much as 2000 pounds, under clean-room conditions, and dealing with vibration, shock, and precision alignment issues."

In his other role, he is responsible for the specification and interface of the control and electrical systems for a 30,000-pound automated vehicle system, used for NIF operations optic delivery. Integration of all the various Lab and vendor components is a fairly involved process. "Careful attention must be paid to hardware selection, software design, and consistency with the controls system architecture."

Donn appreciates the way the Lab encourages "leading out"—building extensions of Laboratory technology to different areas, and to academic and industrial partners. "This type of atmosphere enables you to gain experience on a variety of different projects all under one roof."

Louis Bertolini

When Lou Bertolini graduated with a B.S. in engineering from California Polytechnic Institute, San Luis Obispo, it was 1978. When he evaluated his two job offers—one from a large petroleum company on the East Coast and the other from Lawrence Livermore—it wasn't a hard decision. "For me, the Lab had by far the more interesting job," he said, "one that involved challenging technical work."

For the next ten years, Lou developed a variety of mechanical systems for programs throughout the Laboratory. For instance, he helped to design separator hardware to demonstrate the feasibility of separating uranium and plutonium isotopes using very-high-power lasers. In 1990, he worked on the Super-High Altitude Research Project, the world's largest giant gas gun. "For most of that project, I was the only mechanical engineer," Lou said. "And I had to do whatever it took to get the system up and going." Next, he worked on a team developing a new rocket propulsion concept. "The flight test for the propulsion system at Vandenberg Air Force Base required the rocket to accelerate on a guide rail until it was traveling fast enough to fly stably. We needed to test this rail system first. So, we designed and built the guide rail and the launch tower, and worked with a model rocket club to develop a full-scale model rocket for our rail test at the Lab's Site 300. I'm proud to say, we launched the one and only rocket in Site 300's history!"

In '94, Lou joined the Livermore engineering team designing a system—the "B Factory"— to look for B mesons at the Stanford Linear Accelerator Center (SLAC). As part of that project, he developed an ultra-high vacuum pump (10^{-9} to 10^{-10} torr) used by SLAC's high-energy physicists. "There are no large particle accelerators here at the Lab," explained Lou. "But we regularly build experimental systems used on some of the world's largest particle accelerators, such as those at Brookhaven National Laboratory and SLAC." Lou now heads up that engineering group. In addition to his managerial responsibilities, he maintains a technical role. "I need to continue technical work at some level," he said. "First, I love the work itself, and second, I find it's invaluable to me as a manager. For instance, I put some QC processes into place. Since I'm still engineering mechanical hardware, I found out first-hand how painful some of those practices were. I was then able to make some mid-course corrections."

About Engineering at the Laboratory, Lou notes, "When I look back over my years at the Lab, I've had five to six mini-careers. I've supported many different programs, yet remained an Engineering employee the entire time. Those sorts of opportunities are hard to find elsewhere."

Another thing Lou likes about the Lab is that he works on projects from design through fabrication and testing. "In many places outside the Lab, MEs design things, but never get to see the actual system they design! I'll tell you, I've never made a mistake on paper. It's only by following a system through its assembly, test, and operation that the flaws become apparent. It's only by being involved in the whole process that I learn lessons I can apply to the next job."

Safeguarding the Nation's Future

The Laboratory's mission responsibilities include application of special capabilities to meet a variety of enduring national needs. Our unique technologies in laser research, biotechnology, and environmental sciences are directed at improving energy, security, environmental quality, human health, and the nation's science and technology base. The Laboratory's research and development activities address a broad range of risks to the U.S. and are targeted at improving the well being of its populace in the twenty-first century.

Laser research

Laboratory researchers are pursuing the inertial confinement fusion (ICF) approach to fusion energy through the National Ignition Facility. At the same time, the Laboratory is pioneering the use of laser-based microtechnologies, including extreme ultraviolet lithography for integrated circuit manufacturing. The Lab also researches the use of radar in industry and defense. Scientists and engineers are exploring the uses of laser, x-ray, and ICF technologies in areas such as healthcare, microelectronics fabrication, and vision enhancement. Finally, researchers are developing technologies for the processing, manufacture, storage, and disposal of strategic nuclear materials, principally uranium and plutonium.

As an engineer, you might use your precision engineering skills to design and engineer hardware that resolves surface features and surface finishes on the order of a nanometer. Or, you might engineer the advanced optics and lens coatings required to develop these laser technologies. You may support advanced thermal and structural modeling, using finite element analysis techniques to ensure that outside influences do not compromise system integrity. As an automatic control engineer, you might develop feedback control loops incorporating "learning" to provide real-time system corrections as the physical hardware degrades. These are just a few of the many avenues open to you as an engineer supporting laser research at the Laboratory.

Potassium diphosphate crystals, the largest grown in the world, can be finished to exacting optical specification in the National Ignition Facility.

Biotechnology program

Through human genome work, the Laboratory's bioscientists are decoding DNA and investigating the detailed processes involved in DNA replication and DNA damage. Scientists and engineers are also developing novel healthcare technologies, such as microsurgical tools and medical lasers.

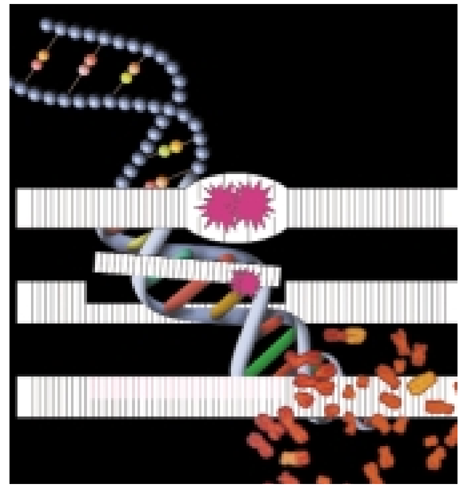
Engineers are key to the Laboratory's bio-instrumentation effort, including automation/robotics, flow cytometry, nucleic-acid analysis, image capture, and image analysis. If you were to work in this area, you might be designing modifications to existing systems or inventing new systems.

The medical technology program focuses multi-disciplinary teams on physician-defined medical needs to provide new, cost-effective technology to the healthcare industry. Projects in this program include the embolic coil-release system for repairing cerebral aneurysms, the advanced catheter, and ultrasound mammography. Engineers have developed and fabricated micromechanical devices for health care and devised imaging systems for breast cancer detection.

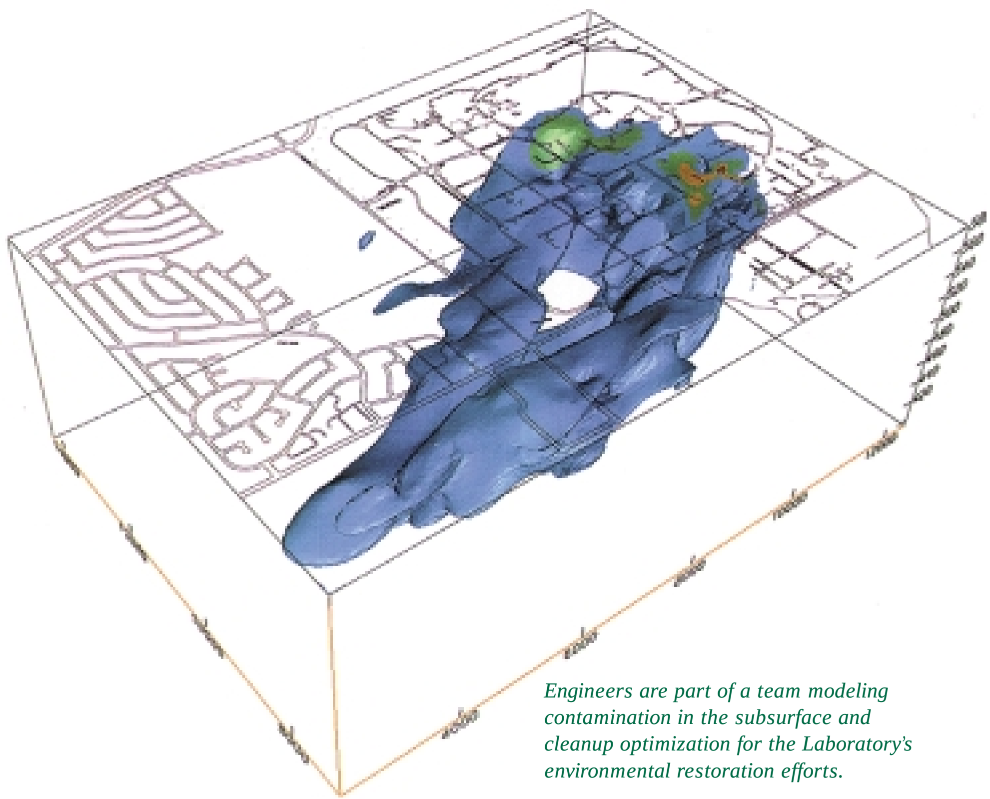
Environmental sciences

At the Laboratory, researchers are trying to understand the complex, interrelated processes that govern global climate. They also are exploring the effects of human activities on the environment. Other scientists and engineers are developing technologies for preventing pollution and for cleaning contaminated soil and water.

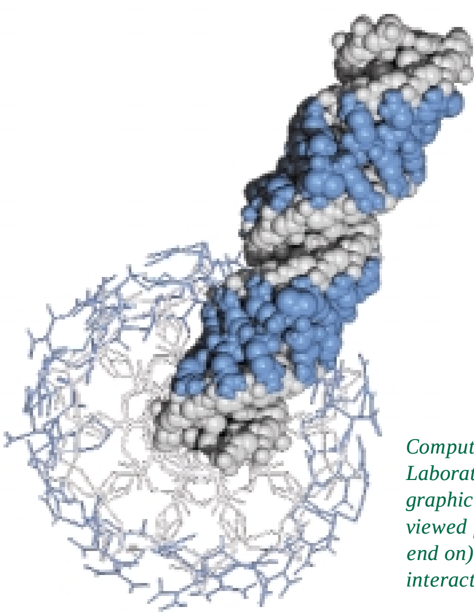
Within Engineering, we have developed instrumentation for detecting hazardous chemical and biological materials in the field. As an engineer supporting the environmental area, you would work with scientists and sponsors, exploring activities to help provide for incident response, decontamination procedures, and validation.



Scientists are working to identify and understand the function of genes responsible for DNA repair. This graphic shows the steps in one DNA repair pathway called excision repair.



Engineers are part of a team modeling contamination in the subsurface and cleanup optimization for the Laboratory's environmental restoration efforts.



Computer modeling is an integral part of the Laboratory's structural biology research. This graphic combines two views (space filling viewed from the side and stick model viewed end on) of the protamine molecule (blue) as it interacts with the DNA molecule (white).

Jose E. Hernandez — Profile

When Jose E. Hernandez interviewed at the Laboratory in 1985, he was immediately drawn to the rural feel of the Livermore area and the surrounding hills. “I also interviewed at companies in the Silicon Valley and Los Angeles,” he noted, “but the Lab's location, and the challenging work it offered in signal processing, really attracted me.”

Jose received a B.S.E.E. from the University of Puerto Rico and an M.S.E.E. from Georgia Institute of Technology. He worked two years for a commercial research and development laboratory on the East Coast before coming to the Lab.

At the start of his Lab career, Jose worked on SIG (a general-purpose signal-processing package developed by the Laboratory), adding enhancements to support several array signal processing projects. From there, his interests led to image processing, “I basically learned as I went,” he said. “I took some University of California, Davis, courses here onsite. I ended up spending about two years developing a library of image processing and pattern recognition algorithms.” He also created VISION, a LISP-based object-oriented environment for developing image processing and pattern recognition programs.

His next challenge was to develop real-time image processing systems. Jose became the principal investigator (PI) of three exciting projects. The first, called Lifeguard, was a real-time image processing system for tracking bullets in flight. Next, in a cooperative agreement with the textile industry, Jose and PIs from six other national laboratories joined together to develop a system for finding defects in fabrics. CAFE, the resulting computer-aided fabric evaluation system, garnered interest from the New York Times, CNN, and ABC. He's now working with the paper industry to develop a system that will monitor several properties of the paper “web” online during the manufacturing process.

“One of the great things about the Lab,” Jose said, “is that you can move around, work in different projects with different people, and still stay within Engineering. In my years here, I've worked on a variety of R&D projects including several industrial collaborations. In a way, it's up to me what I'll be doing next year. The work is the number one reason I came here. There's lots of flexibility, and lots of ways to go as an engineer.”

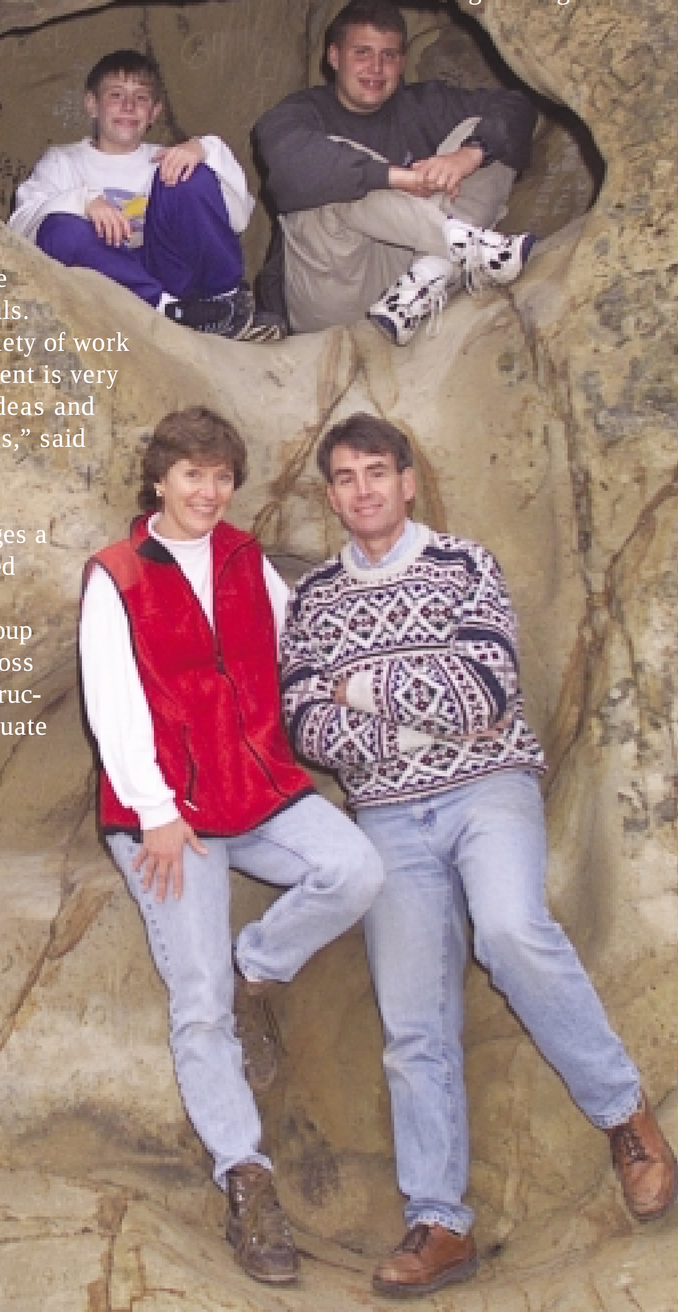
Jose is currently a project engineer leading several large projects utilizing the Lab’s unique Micropower Impulse Radar technology. He is also the acting Group Leader for the Signal/Image Processing and Controls Group in the Electronics Engineering Department.

When Monika Witte received her M.S. in Civil Engineering from the University of California at Davis, she had several offers to choose from, including her previous employer. “The Lab seemed so much more exciting, and today I know it’s true—you can’t beat it for the sheer number of highly technical people working in one place on so many different types of projects,” said Monika.

For 16 years, Monika was “matrixed” to the Energy Directorate, supporting the Fission Energy and Systems Safety Program. Starting as an engineer performing structural analysis and eventually becoming a group leader, Monika and her team performed reviews for the Nuclear Regulatory Commission and the Department of Energy to ensure the adequacy of container packaging for transport and storage of radioactive materials. “I worked with a multi-disciplinary team made up of chemical, mechanical, and nuclear engineers, along with operations specialists,” said Monika. “This was the first time I had had the opportunity to work on such a diverse team, with each member providing a different perspective on the same problem. It was so challenging; I was really glad I had picked the Lab.”

During this period, Monika worked with the Nuclear Regulatory Commission to determine the earthquake levels that should be considered when building new nuclear power plants. She also led the development of a process to review medical plans intended to ensure the safe handling and application of radioactive materials in hospitals. “There’s a large variety of work here, and management is very supportive of new ideas and new job assignments,” said Monika.

Today Monika manages a structural and applied mechanics group in Engineering. This group provides support across the Lab, including structural analysis to evaluate vibration loads for the National Ignition Facility. “The thing that amazes me, though, is that new projects are always starting,” said Monika. “Just recently, we were brought into a project to perform some structural analysis on a piece of radiation detection hardware. Next thing we knew, they asked us to take over the development of the hardware. The team is now developing new skills, both technical and project management, and we’re meeting new people. That’s flexibility and opportunity—and that’s why I stay in Engineering.”



CONTINUE YOUR EDUCATION

The Engineering organization and the Laboratory as an institution are committed to keeping employees up-to-date in their fields. Because engineering technologies change rapidly, we promote professional development in many ways.

First, within Engineering there is ample opportunity to change assignments to broaden your work experience and promote career growth.

You can also explore new areas of engineering through the Laboratory's continuing education program. Each year, hundreds of technical short courses, including seminars and lectures, are sponsored onsite to provide leading-edge information. The Laboratory offers quarterly classes on nontechnical subjects, such as management and communication. In Engineering, we offer diversity training to all Engineering employees so that they develop an understanding of the business and ethical necessity for diversity.

Employees are encouraged to pursue "career-long learning." There are associated programs at over 30 Bay Area colleges and universities. Closed-circuit television links the Laboratory with the University of California campuses at Davis and Berkeley, and with Stanford University; a satellite connects the Laboratory with the National Technological University.

In addition, the University of California at Davis has a Department of Applied Science at the Laboratory site. The department grants graduate degrees in engineering/applied science and computer science.

Recently, Engineering implemented the Leadership Development Program. This program was pioneered to build a pool of trained younger employees to be ready to take on leadership tasks as openings occur; offer opportunities for younger employees to develop in lead roles, including line, technical, program, project, and institutional; and provide advanced training for people currently within Engineering.

We also encourage employees to attend outside conferences, seminars, and short courses, and to visit other research institutions to help keep abreast of current advances.

From the start, your future here is up to you. You'll find your performance, interests, and continuing education will accelerate your career path as a Lawrence Livermore engineer.

RECEIVE A COMPETITIVE SALARY AND FIRST-CLASS BENEFITS

Our salaries are competitive with private industry. As a University of California employee working at the Laboratory, you immediately receive a full range of benefits. There are 12 paid holidays a year. Full-time employees earn three weeks of vacation a year, increasing after 10 years of service. The Laboratory also offers a wide range of insurance programs—including health, vision and dental—and retirement plans, including a tax-deferred 403(b) savings plan and a defined-benefits pension plan.

The Employee Services Association

Another benefit is automatic membership in the Laboratory's Employee Services Association (LLESA). Laboratory employees and their families are encouraged to pursue their fitness, cultural, educational, community service, and social interests through LLESA's activity groups, ranging from organic gardening to chess. LLESA also manages an Olympic-size swimming pool onsite, which offers swimming lessons all summer to employees and their families, and supports Masters swimming and underwater hockey. Noontime lap swimming is available year-round to employees. Running, walking, aerobics, and rollerblading are also popular noontime activities.

In addition, the association manages an onsite employee store and a parent-supported childcare center just a few minutes' drive from the Laboratory's main site. The center accepts children from six weeks old through the fifth grade.

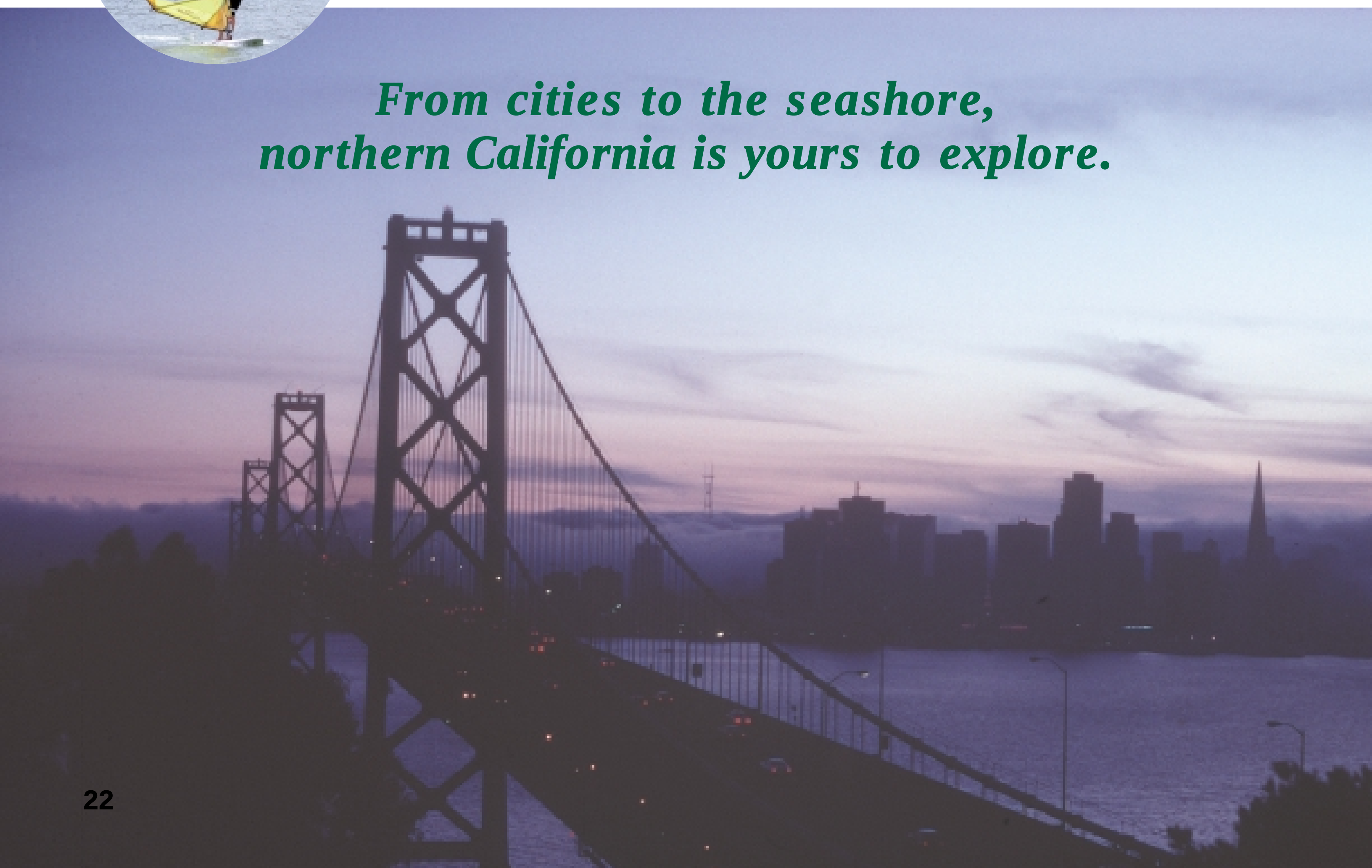
ENJOY THE AREA

The Livermore Valley offers a rural/suburban environment with easy access to cities, beaches, and mountains. The Valley is home to two dozen wineries, a community symphony and opera company, and eight golf courses.

The Valley also has a full range of recreational activities just a few minutes away from the Laboratory. Windsurfers skim the waters at Del Valle or Shadow Cliffs regional parks. Del Valle and nearby Sunol regional parks provide trails for the casual stroller and serious hiker, as well as overnight camping opportunities. Cyclists can find scenic flat country lanes as well as steep, challenging climbs in the nearby hills.

One hour to the west is San Francisco, with the metropolitan centers of San Jose and Oakland closer still. Berkeley with the University of California and Palo Alto with Stanford University are only 50-minute commutes from Livermore. These cities are close enough to make an evening at the theatre, ballet, or symphony an easy drive. Museums and galleries beckon from San Francisco and other Bay Area cities. BART (Bay Area Rapid Transit) provides easy public transportation via rail and bus to cities such as San Francisco, Berkeley, and Oakland. The newly implemented Altamont Commuter Express (ACE Train) offers alternative transportation from the Central Valley.

West of San Francisco is the Pacific Ocean. The scenic Pacific Coast from Monterey and Big Sur in the south to the Mendocino Coast in the north are all within a three-hour drive. If you head east, the Sierra Nevada (with Yosemite and Lake Tahoe) are also about three hours away, offering unparalleled camping, hiking, skiing, and climbing.



HAVE A QUESTION? WANT TO APPLY?

We are looking for engineers in the following fields but welcome all inquiries:

- Mechanical/design engineering
- Electrical/electronics engineering
- Optical engineering
- Systems and test engineering
- Controls/embedded systems engineering
- Information systems
- Computer security
- Microtechnology (MEMS, microfluidics)
- Computer/software/network engineering
- Structural analysts and code developers
- Nuclear engineering

You can apply through our Website at www.llnl.gov/jobs. You can also apply by mailing a cover memo, expressing your job objectives and career interests, along with your personal resume and a complete employment history to:

Lawrence Livermore National Laboratory
Attn. Recruiting and Employment
Dept. HOPG, L-725
P.O. Box 5510
Livermore, CA 94551-5510

Students: visit our Website at *www.llnl.gov/campus* for information about specific positions and our college recruitment program.

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